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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Application of:	Maydan and Samoilov	Confirmation No.:	4582
Serial No.:	09/866,172	Art Unit:	1765
Filed:	May 24, 2001	Examiner:	Robert M. Kunemund
For:	METHOD FOR FABRICATING WAVEGUIDES	Attorney Docket No:	005926/AKT/RKK (10732-022-999)

BRIEF ON APPEAL FEE TRANSMITTAL

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

An original and two copies of the applicant's Brief on Appeal in the above-entitled application are submitted herewith. The item(s) checked below apply:

☒ The Brief filing fee is $330.00
☐ Applicant has qualified for the 50% reduction in fee for an independent inventor, nonprofit organization or small business concern and the Brief filing fee is $165.00

The brief filing fee is:

☒ Required.
☐ Not required. (Fee paid in prior appeal.)

Please charge the required Brief filing fee to Pennie & Edmonds LLP Deposit Account No. 16-1150. A copy of this sheet is enclosed.

Respectfully submitted,

Date: November 19, 2003

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Enclosure

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APPEAL BRIEF

Mail Stop Appeal Brief - Patents
Honorable Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

Sir:

This is an appeal pursuant to the provisions of 37 C.F.R. § 1.192 from the Examiner's final rejection of claims 1-61 of June 11, 2003. Claims 1-61 were rejected under 35 U.S.C. §103(a) as being unpatentable over United States Patent No. 5,891,769 to Liaw *et al.* (hereinafter "Liaw") in view of Pogossian *et al.*, 1999, J. Opt. Soc. Am. A. 16, p. 591 (hereinafter Pogossian).

The Notice of Appeal was filed on October 14, 2003. An amendment under 37 C.F.R. § 1.116 accompanies this brief.

1. REAL PARTY IN INTEREST

The real party in interest is Applied Materials, Inc. Applied Materials, Inc. is a corporation having headquarters at 3050 Bowers Avenue, Santa Clara, California 95054, by whom the inventors are employed. An assignment of the invention from inventors Dan Mayden and Arkadii Samoiloav to Applied Materials was recorded on January 4, 2002 on reel 012449 / frame 0587.

2. RELATED APPEALS AND INTERFERENCES

There are no interferences or other appeals related to the present application.

3. STATUS OF CLAIMS

On October 14, 2003, Applicants appealed from the final rejection of claims 1-61. Upon entry of a 37 C.F.R § 116 amendment filed on even date herewith, claims 1-22, 51-56, and 60 remain in the application.

4. STATUS OF AMENDMENTS

Applicants have filed an amendment under 37 C.F.R § 116 on even date herewith. All other amendments filed by the Applicants have been duly entered by the Examiner.

5. SUMMARY OF THE INVENTION

The present invention is directed to methods of forming novel planar waveguide structures as well as computer readable medium encoded with instructions for forming such structures. As indicated in paragraphs 2 and 3 of Applicants' specification, planar optical waveguides are widely used in optical communication systems. A conventional planar waveguide structure comprises a lower cladding region, a light guiding core region and an upper cladding region. The light guiding core region has a higher index of refraction than either the lower or the upper cladding regions. In many instances, the light guiding core region is made of SiGe and the cladding regions are made of silicon.

Applicants' figure 2 illustrates a planar waveguide formed using Applicants' inventive processes. As described in paragraphs 33-47 of the specification, the planar waveguide includes a first graded layer 230, an optional uniform layer 240, and a second graded layer 250. As indicated in paragraph 37 of the specification, the first graded layer 230 comprises two optical materials and the concentration of the first optical material increases with the height of layer 230. As indicated in paragraph 39 of the specification, the second graded layer 250 can comprise the same two optical materials used to form the first graded layer 230, but the concentration of the first optical material decreases with the height of graded layer 250. Paragraph 44 of the specification states that, in one embodiment, the two optical materials are silicon and germanium.

Paragraphs 48 and 49 as well as figure 3 of Applicants' specification describe the concentration profiles that can be used in graded layers 230 and 250. Figs. 3(c) and 3(e) are of particular interest because they illustrate concentration profiles in which there is no uniform layer between graded layers 230 and 250. See also, page 9, lines 30-31, of Applicants' specification, where it is stated that Figures 3(c) and (e) illustrate concentration profiles of structures that do not contain an intermediate uniform layer.

6. ISSUES

Upon entry of the amendment under 37 C.F.R. § 1.116 filed on even date herewith, the issues presented are whether claims 1-22, 51-56, and 60 are patentable under 35 U.S.C. § 103(a) over Liaw in view of Pogossian.

7. GROUPING OF CLAIMS

Claims 1-22, 51-56, and 60 are pending in this case. Many of the pending claims are believed to be separately patentable and do not stand or fall together. However, the arguments provided in Section 8 below are applicable to all the pending claims.

8. ARGUMENTS

In the final Office Action, dated June 11, 2003, Examiner Kunemund presented four separate rejections under 35 U.S.C. § 103(a) over Liaw in view of Pogossian:

(I) claims 1-6, 9, 12-14, 16, 17, 20 and 60;

(II) claims 7, 8, 10, 11, 18, 19, and 21;

(III) claims 15, 22-50, 57, 59 and 61; and

(IV) claims 51-56.

The group (IV) rejections are based upon the same issues as the group (I) rejections. Further, each of the claims in groups (II) and (III) that remain pending depend from claims 1 group (I), 51 (group IV), or 60 (group I). Therefore, for conciseness, Arguments are presented as to why independent claims 1, 51, and 60 are patentable over the combination of Liaw in view of Pogossian. Then, it is asserted that all other claims in Groups I through IV that remain pending in the case are patentable over Liaw in view of Pogossian because they ultimately depend from claims 1, 51, or 60.

Applicants respectfully submit that claims 1, 51, and 60 are fully patentable over the combination Liaw and Pogossian. On page 2 of the June 11, 2003 Office Action, the Examiner stated that Liaw teaches the deposition of a silicon-germanium layer in which the germanium concentration increases as a function of the height of the layer, a layer of constant composition SiGe deposited on the first layer, and a third layer of graded SiGe in which the germanium concentration decreases as a function of the height of the layer. The only reference to such a structure is found at column 1, lines 27-39, of Liaw. However, the structure at column 1, lines 27-39, of Liaw cannot be equated to the structure recited in Applicants' claims 1, 51, and 60. Claims 1, 51, and 60 recite the formation of a second graded layer *immediately over* a first graded layer. As such, claims 1, 51, and 60 do not indicate a structure that includes the intermediate layer of constant SiGe composition described by Liaw at column 1, lines 27-39.

No reference in the entirety of Liaw is made to the structures formed by the methods recited in Applicants' claims 1, 51, and 60. In fact, at the bottom of page 2, of the June 11, 2003 Office Action, the Examiner admits that Liaw differs from the rejected claims by the addition of a cladding layer and no intervening layers. At the top of page 3 of the Office Action, the Examiner goes on to state that figure 3 of Pogossian teaches a SiGe device with silicon cladding layers deposited below and above the graded layers. While this may be the case this does not describe a structure in which a second graded layer is formed immediately over a first graded layer. Thus, even if Liaw and Pogossian were fairly combined, the combination still fails to teach or suggest forming a second graded layer *immediately over* a first graded layer (*i.e.*, *without* an intervening layer of constant concentration) as indicated in claims 1, 51, and 60. For this reason, claims 1, 51, and 60 are fully patentable over the combination of Liaw and Pogossian.

As an additional matter, Liaw teaches away from the structure disclosed in column 1, lines 27-39, of Liaw. In particular column 1, lines 35-39, of Liaw states:

> This approach [to forming a strained silicon channel layer] has several disadvantages including a high epitaxial film cost because it takes approximately 6-8 hours to grow the different layers. Additionally, this approach results in a high concentration of threading dislocations because of the thick epitaxial layers.

Based on these teachings, one of ordinary skill in the art would not have been motivated to take a process for making a structure that is disavowed in Liaw and modify it in any way in view of Pogossian. Claims 2-22, and 52-56 ultimately depend from claim 1 or 51 and are

therefore patentable over the combination of Liaw and Pogossian for at least the same reasons that claims 1 and 51 are patentable over such combination of references.

9. CONCLUSION

For all of the foregoing reasons, reversal of the rejections of claims 1-22, 51-56, and 60 is respectfully requested.

Respectfully submitted,

Date: November 19, 2003

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APPENDIX A

APPEALED CLAIMS (UPON ENTRY OF THE ACCOMPANYING AMENDMENT UNDER 37 C.F.R. § 1.116)

1. (Previously amended) A method of forming a planar waveguide structure, comprising:

forming a first graded layer on a substrate, the first graded layer comprising silicon and germanium wherein the germanium concentration increases with the height of the first graded layer; and

forming a second graded layer immediately over the first graded layer, the second graded layer comprising silicon and germanium wherein the germanium concentration decreases with the height of the second graded layer.

2. (Original) The method of claim 1 further comprising forming a blocking layer between the substrate and the first graded layer wherein the blocking layer prevents contaminants from the substrate from diffusing into the first or the second graded layers.

3. (Original) The method of claim 2 wherein the blocking layer comprises epitaxial silicon.

4. (Original) The method of claim 1 further comprising forming a cladding layer on the second graded layer.

5. (Original) The method of claim 4 wherein the cladding layer comprises epitaxial silicon.

6. (Original) The method of claim 1 wherein the germanium concentration in the first graded layer increases linearly.

7. (Original) The method of claim 1 wherein the germanium concentration in the graded layer increases from about 0% germanium to about 2-5% germanium at a rate between about 0.1% per μm to about 10% per μm.

8. (Original) The method of claim 1 wherein the germanium concentration in the first graded layer increases from about 0% germanium to about 2% germanium at a rate of about 10 % per μm.

9. (Original) The method of claim 1 wherein the germanium concentration in the second graded layer decreases linearly.

10. (Original) The method of claim 1 wherein the germanium concentration in the second graded layer decreases from about 2-5% germanium to about 0% germanium at a rate between about 0.1% per μm to about 10% per μm.

11. (Original) The method of claim 1 wherein the germanium concentration in the second graded layer decreases from about 2% germanium to about 0% germanium at a rate of about 10% per μm.

12. (Original) The method of claim 1 wherein the layers are formed by a chemical vapor deposition process.

13. (Original) The method of claim 12 wherein the layers are formed epitaxially.

14. (Original) The method of claim 12 wherein the chemical vapor deposition process is a low pressure chemical vapor deposition process.

15. (Currently amended) The method of claim ~~13~~ 1 wherein the planar waveguide structure is formed using a selective deposition technique.

16. (Currently amended) The method of claim ~~13~~ 12 wherein the chemical vapor deposition process comprises:

introducing into a deposition chamber a first source gas for forming silicon film on a substrate;

introducing into a deposition chamber a second source gas for forming SiGe film on a substrate; and

introducing H_2 into the deposition chamber while maintaining a determined pressure and temperature in the deposition chamber.

17. (Original) The method of claim 16 wherein the first source gas is silane, disilane, trisilane, dichlorosilane, or trichlorosilane.

18. (Original) The method of claim 16 wherein the second source gas is germane or digermane.

19. (Original) The method of claim 16 wherein the first source gas is silane and the second source gas is germane.

20. (Previously amended) The method of claim 16 wherein the chemical vapor deposition process for forming the first and second graded layers comprises:

controlling the flow rate of the second source gas according to a determined concentration profile of Ge on a substrate; and

forming a film on a substrate, the film comprising Ge at a first concentration at a first point in the film and a second concentration different from the first concentration at a second point in the film.

21. (Original) The method of claim 20 wherein the concentration profile is determined by:

determining a concentration of Ge formed on a substrate for a plurality of flow rates;

determining a growth rate of SiGe on a substrate for a second plurality of flow rates;

determining a concentration profile of Ge for a unit of time; and

controlling the flow rate to form film at a graded concentration of Ge throughout the thickness of the film.

22. (Original) The method of claim 1 further comprising:

forming a pattern on the first graded layer; and

etching the patterned first graded layer before forming the second graded layer on the first graded layer.

23-50. (Cancelled)

51. (Previously amended) A computer readable medium comprising executable program instructions that when executed cause a digital processing system to perform a method comprising:

forming a first graded layer on a substrate, the first graded layer comprising silicon and germanium wherein the germanium concentration increases with the height of the first graded layer; and

forming a second graded layer immediately over the first graded layer, the second graded layer comprising silicon and germanium wherein the germanium concentration decreases with the height of the second graded layer.

52. (Currently amended) The computer readable medium ~~method~~ of claim 51 wherein the executable program instructions include instructions for forming layers using a chemical vapor deposition process.

53. (Currently amended) The computer readable medium ~~method~~ of claim ~~51~~ 52 wherein the chemical vapor deposition process comprises executable program instructions for:

introducing into a deposition chamber a first source gas for forming silicon film on a substrate;

introducing into ~~a~~ the deposition chamber a second source gas for forming SiGe film on a substrate; and

introducing H_2 into the deposition chamber while maintaining a determined pressure and temperature in the deposition chamber.

54. (Currently amended) The computer readable medium ~~method~~ of claim 51 wherein the executable program instructions for forming the first and second graded layers comprises instructions for:

controlling the flow rate of the second source gas according to a determined concentration profile of Ge on a substrate;

forming a film on a substrate, the film comprising Ge at a first concentration at a first point in the film and a second concentration different from the first concentration at a second point in the film.

55. (Currently amended) The computer readable medium ~~method~~ of claim 54 wherein the executable program instructions for determining the concentration profile ~~comprises~~ comprise instructions for:

determining a concentration of Ge formed on ~~a~~ the substrate for a plurality of flow rates;

determining a growth rate of SiGe on ~~a~~ the substrate for a second plurality of flow rates;

determining a concentration profile of Ge for a unit of time; and

controlling the flow rate to form film at a graded concentration of Ge throughout the thickness of the film.

56. (Currently amended) The computer readable medium ~~method~~ of claim 51 wherein the executable program instruction include instructions for forming the layers epitaxially.

57-59. (Cancelled)

60. (Previously amended) A method of forming a planar waveguide structure, comprising:

forming a first graded layer on a substrate, wherein the first graded layer comprises a first and a second optical material, wherein the concentration of the first optical material and the index of refraction of the first graded layer increases with the height of the first graded layer; and

forming a second graded layer immediately over the first graded layer, the second graded layer comprising the first and second optical materials wherein the concentration of the first optical material and the index of refraction of the second layer decreases with the height of the second graded layer.

61. (Cancelled)